Revegetation of Chihuahuan Desert Ecosytems

The purpose of this project is to develop an understanding of revegetation of disturbed areas using native plants and native plant propagules, and to develop opportunities to assist Carlsbad Caverns National Park in revegetating some disturbed areas. Students will study the desert communities within the park with an emphasis on reviewing the individual characteristics of native plant species that make them good candidates for replanting on disturbed sites. Plant communities adjacent to disturbed sites will be surveyed to determine appropriate species for replanting those sites. The students will assist in the revegetation of a disturbed site by a combination of possible methods: a) planting locally collected native seeds, b) replanting salvaged native plants that have been uprooted by construction, and c) germinating and growing selected native plants to produce transplants. Student teams will return to the site six times during the first year to water the plant starts and measure the survival rate for the selected native species. The natural recruitment of native plants and the invasion of exotic species on the disturbed site will be monitored. The exotic species will be removed. The monitoring data collected will help evaluate revegetation procedures for the northern Chihuahuan Desert area.

Student Objectives

Student objectives are as follows:

- Inventory desert plant communities.
- Replant salvageable native vegetation in a disturbed site.
- Learn techniques for germinating, transplanting, and growing native plants.
- Work in teams to collect scientific information on plant survival.
- Make recommendations for restoration of impacted lands within the park.
- Make recommendations for the plants with the best chance of survival.

Revegetation Background

Because native plants are difficult to establish from seed, land managers in the past used introduced (non-native) plants. This trend began to change in the 1970s, when it was recognized that introduced plants often replaced native plant populations, destroying the naturally functioning ecosystems the national parks are created to preserve. Modern-day activities, such as construction and other park activities, create disturbed sites within the park.

Plant establishment from seed requires viable seed and a favorable environment for germination and seedling development. Some seeds will germinate but seedlings may die because inadequate soil moisture has limited the development of a root system. To increase the success of plant establishment, foresters (Tinus 1978), landscape architects (Aratani 1976), mine reclamationists (Howard *et al.* 1978) and wildlife biologists (Springfield 1972, Ferguson *et al.* 1975) have transplanted containerized greenhouse-grown seedlings and provided supplemental irrigation during

establishment. However, many times in national parks, supplemental water cannot be practically or easily provided. The revegetation techniques most likely to succeed are those that work with the natural system and native species.

Seed Collection Procedures

Species

The following species seeds are among those that can be collected. Other species could be used from a list generated by the Resource Management staff of Carlsbad Caverns National Park.

- Western Soapberry Tree (*Sapindus saponaria*)
- Mescal Bean *(Sophora secundiflora)*
- Mexican Buckeye *(Ungnadia speciosa)*
- Netleaf Hackberry *(Celtis reticulata)*
- Green Sprangletop *(Leptochloa dubia)*
- Plains Bristlegrass *(Setaria macrostachya)*
- Blue grama *(Bouteloua gracilis)*
- Sideoats grama *(Bouteloua curtipendula)*

Seed and Collections

Any seed collecting inside the park must be done after applying for and receiving an approved research/collecting permit from Carlsbad Caverns National Park. Collections will be recorded and the following site data collected: 1) location established with GPS, 2) date of collection, 3) general soil conditions, 4) elevation, and 5) a detailed description of plant characteristics. Only ten percent (10%) of available seeds in an area will be harvested, the remainder will be left to germinate.

The Carlsbad Caverns National Park Resource Management Office should be notified at least one week in advance of date and time of seed collecting. A resource management employee may be assigned to assist the group doing the collection. Seeds collected in a given area will be packaged and marked with (1) species, (2) location and (3) date.

Seed Germination and Seedling Development

25 seeds of each species should be placed on Whatman No. 1 filter paper in separate petri dishes. Approximately 10mL of distilled water will be added to each petri dish at the beginning of the study, and seeds germinated at 15, 20, 25, and 30^{o} C in a seed germinator with no less than 10 hours of light and 14 hours of dark. Germination will be considered complete when the seed radical is more than 0.5 cm in length.

Petri dishes will be arranged in a stratified random block design within the germinator to measure potential temperature differences in the germinator. Total germination will be determined by accumulating the number of germinating seeds over a 14-day period. Germination will be compared with analysis of variance at Day 6 and Day 12. When *F*

values are significant, a Tukey's w-procedure will be used to separate means (Tukey 1977).

Greenhouse soils will be screened to 5mm and thoroughly mixed and treated to remove non-native plant seeds. Soils will be added to 150mm X 150mm tapered plastic pots. 25 seeds of one species will be sown on the media surface of each pot. All pots will be monitored for the emergence of non-native plants during the experiment. Any that are discovered will be removed immediately, and none will be planted in the park.

Pots will be placed in 0.15m X 1.50m X 2.25m sheet metal pans, and sub-irrigated with distilled water. Sub-irrigation will be used to ensure that soil surfaces are moist and undisturbed. Emergence will be considered complete when the first leaf is 15mm above the soil surface in those pots where seeds are planted at 5mm to 320mm depths; or when the first leaf is 15mm above the soil surface and the radical has penetrated the soil in those pots in which seeds were sown on the soil surface. Seedling counts will be made daily.

Planting, Data Collection and Monitoring of Disturbed Soil

Carlsbad Caverns National Park staff will direct restoration with assistance from students.

A hand spade will be used to remove soil from prepared holes. The transplant will be extracted from the cone-tainer and placed in the hole. Soil will be hand packed around each transplant so that the transplant medium surface and the soil surface within the hole are depressed 1 to 2cm below the soil surface. Immediately following transplanting, the plants will be watered. Subsequent watering may take place, depending on the season, rainfall, and other factors.

For example, a 250' X 50' disturbed site could be partitioned into five 50' X 50' areas to examine effective restoration treatment practices. This could be done as follows:

Area 1—Natural control
Area 2—Reseeded and watered once at seeding
Area 3—Reseeded and watered once per month (estimate)
Area 4—Transplanted and watered once at planting
Area 5—Transplanted and watered once per month (estimate)

Revegetated areas will be monitored for success in future seasons. This may be accomplished by use of photo-monitoring, transects, or combinations with other monitoring techniques. From surviving plants, measurements will be made to determine basal area, plant height and seed production. Experimental monitoring will assess plant germination rate and transplant survival. The number of live plants, those with green leaves, will be counted in early fall and late spring.

References Cited

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